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Attitude vs. infrastructure: Influences on the intention to overtake bicycle riders

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ABSTRACT

The Theory of Planned Behavior (Ajzen, 1991) has recently gained some heightened attention in the traffic safety community in predicting risky behavior. On the other hand, infrastructure layout has often been shown to influence road user behavior in direct ways in traffic observations. In an online survey, 108 holders (81% female) of a valid car-driving license reported on their attitude, social norms, and perceived behavioral control towards overtaking bicycle riders with a smaller than legal margin. Additionally, they rated their willingness to overtake a bicycle rider as well as perceived risk for six traffic sketches. In these sketches, infrastructure layout was systematically varied on two dimensions: (1) streets with or without a center-line between directions of travel and (2) streets marked with either a cycle lane, an advisory lane for bicycle riders or none of these. A repeated measures ANOVA with center line and cycling street markings as independent variables and attitude, social norms, and perceived behavioral control as covariates showed that intention to overtake was only influenced by street markings and the interaction of attitude and street markings, showing that intention to overtake was higher with markings than without, and even higher when attitude towards illegally small distances to overtake was more positive. Ratings of risk while overtaking were only influenced by street markings, showing that ratings of risk were lower for any of the marked designs than those without. Data analysis suggests that personal motivations play a far less important role in the intention to overtake bicycle riders with a non-safe distance than infrastructure designs do. Even the judgement of risk for a given situation seems to be influenced by some markings on the street but not by personal motivations.

1. Introduction

Regular cycling is associated with a number of advantages. It leads to better fitness and mobility, saves money, is fun and at the same time protects the environment. In view of the traffic congestions mostly caused by motorized traffic, the bicycle offers an effective alternative. Increased use of the bicycle would result in a reduction in noise, emissions and space taken by traffic (Possert, 2011). In Germany, there is a bicycle availability of 0.9 bicycles per person; 82 percent of all German households owned at least one bicycle in 2008; about one third had three or more bicycles (Follmer et al., 2010). However, only 10 per cent of everyday journeys are made by bicycle (Follmer et al., 2010), because bicycle riders are perceived as very vulnerable in road traffic and this assessment often leads to the choice of the safer car (Skorna et al., 2010). In fact, bicycle riders are at high risk of accidents, as about 26% of all accidents in 2017 involved a bicycle rider; of these 26%, about 58% involved a passenger car as opponent (Statistisches Bundesamt, 2018). Frequent driving errors made by car drivers include inappropriate speeds, inappropriate distances and tight overtaking (Statistisches Bundesamt, 2018), which is also perceived by bicycle riders as very threatening and discourages some people from cycling (Skorna et al., 2010; Haworth and Schramm, 2014).

1.1. Cycling infrastructure in Germany

In Germany, two types of on-street cycling facilities are built on streets with a speed limit of 50 km/h (general speed limit within built-up areas) according to the "Recommendations for cycling infrastructure" (Empfelhungen für Radverkehrsanlagen, ERA, 2010). These are "cycle lanes" and "advisory lanes" (the German term "Schutzstreifen" literally translates to "protective lane"), which are defined as follows: On lanes shared by motorized vehicles and bicycle riders, advisory and cycle lanes define the area for bicycle riders. By default, advisory lanes are 1.50 m wide and should not be narrower than 1.25 m. They are marked on the left by a 0.12 m wide dashed line with lines and gaps of one meter each. Advisory lanes may be crossed by

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motor vehicles if necessary to let oncoming traffic pass. Cycle lanes are 1.85 m wide by standard, including a 0.25 m wide solid lane marking on the left. In contrast to the advisory lanes, these wider lane markings must not be crossed by cars. Cycle lanes must be used by bicycle riders. There are separate regulations for the design at crossings and junctions (ERA, 2010). The minimum distance that must be kept when overtaking bicycles in built-up areas is 1.5 m since April 28th, 2020, according to the German Road Traffic Act. Outside towns, a distance of 2.0 m must be maintained (StVO, 2020). Before April 28th, 2020, and therefore in the time the study was done, no explicit legal limit was given, other than to leave "sufficient space to overtake safely", but legal opinion (see Müller, 2018) generally set the limit to 1.5 m as well.

1.2. Overtaking bicycle riders

The effects of marked on-road infrastructure for bicycle riders (e.g. bike lanes) on drivers' behavior while overtaking bicycle riders have been studies since at least 1977 (Kroll and Ramey, 1977), using different methods like equipped bicycles (e.g. Beck et al., 2019; Chapman and Noyce, 2014; Dozza et al., 2016; Llorca et al., 2017; Love et al., 2012; Mehta et al., 2015; Parkin and Meyers, 2010; Shackel and Parkin, 2014; Stewart and McHale, 2014; Walker, 2007), equipped vehicles (Kovaceva et al., 2018), roadside observations (Kroll and Ramey, 1977), accident analyses (Hon, 2007; Morrison et al., 2019), and driving simulators (Bianchi Piccinini et al., 2018; Caird et al., 2008; Farah et al., 2019; Huemer et al., 2018). This has been done in wide range of settings, ranging from highway shoulders over rural roads (e.g. Bianchi Piccinini et al., 2018; Chapman and Noyce, 2012, 2014; Dozza et al., 2016; Farah et al., 2019; Llorca et al., 2017) to urban settings (Debnath et al., 2018; Mehta et al., 2015; Parkin and Meyers, 2010; Richter et al., 2019; Shackel and Parkin, 2014; Stewart and McHale, 2014); and in various nations (e.g. Australia, Canada, Sweden, United Kingdom, United States). Size and direction of these effects of marked infrastructure on overtaking distances are not straight-forward, therefore only results for urban settings will be discussed here. Even therein, results are mixed: while Love et al. (2012), Mehta et al. (2015), and Stewart and McHale (2014) found that drivers give more room to bicycle rider while overtaking on streets with marked bike lanes, Parkin and Meyers (2010), Shackel and Parkin (2014) found no significant differences, and Beck et al. (2019) as well as Debnath et al. (2018) found a reduction of passing distance on roads with bike lanes. Morrison et al. (2019) found exclusive bicycle lanes to be associated with reduced crash odds.

Even when exclusively looking at German data, results are mixed: in Haag-Bingemann and Hupfer (1996) found no differences in overtaking distances, while recent observations (Huemer et al., 2018; Richter et al., 2019; Tagesspiegel, 2018) showed smaller overtaking distances on marked roads compared to non-marked roads.

Except of the few simulator studies (Huemer et al., 2018), none of the referred studies is able to isolate the predictor of lane marking from other, potentially covarying factors (e.g. the cycling and car driver population at different sites). In their simulator studies, Bianchi Piccinini et al. (2018) and Farah et al. (2019) investigated rural roads, and Caird et al. (2008) unfortunately did not analyze lateral distances while overtaking in their experiment. Huemer et al. (2018) investigated influences of infrastructure layout in a static driving simulator. In a within-subjects-design 60 participants drove through 24 different situations, where, among others, the factors "bicycle infrastructure" and "center line" were manipulated. The results showed that motorists keep significantly closer distance to bicycle rider and drive faster when there are cycle lanes or advisory lanes and when there is a centerline compared to none of those. While simulator studies are able to isolate and therefore causally test influencing factors in traffic, they are, despite being less so than traffic observations, a resourceful approach.

1.3. Personal motivations: The Theory of planned behavior

One of the most prominent models of deliberate behavior in psychological science is the theory of planned behavior (TPB, Ajzen, 1991). The model has been quite successful in predicting a wide range of behaviors, and has also helped to create successful interventions (Armitage and Conner, 2001; Rivis and Sheeran, 2003). Thereby, it has undergone some refinements and extensions to strengthen its predictive qualities (Conner and Armitage, 1998; Norman and Conner, 2006).

Central to the TPB is the idea that any deliberate behavior is determined by behavioral intentions, which are a function of three constructs: attitude, subjective norm, and perceived behavioral control. Attitude refers to the evaluative reactions of a person towards engaging in the target behavior. Subjective norm reflects individuals' perceived expectation that significant others approve or disapprove of the behavior. Perceived behavioral control (PBC) relates to the extent to which a person perceives personal capacities and constraints regarding the target behavior. According to Ajzen (1991), PBC not only influences intention, but also interacts with it to determine observable behavior.

A wide range of studies have specifically demonstrated the TPB's predictive utility for understanding the decision-making processes that leads people to violate traffic rules (e.g. Chan et al., 2010; Elliott and Armitage, 2009; Forward, 2009; Moan and Rise, 2011; Parker et al., 1996; Poulter et al., 2008). The TPB has recently gained some heightened attention in the traffic safety community in predicting risky behavior (e.g. Demir et al., 2019; Earle et al., 2020; Huemer, 2018; Jiang et al., 2019; Murphy et al, 2020; Piazza et al., 2019).

1.4. Aim of the present study

The present study had two aims: on the one hand we wanted to find out if the results obtained in real traffic an in driving simulator studies can also be found with more cost-effective online studies. On the other hand, we wanted to directly compare influences of infrastructure layout and personal motivations with each other.

2. Method

2.1. Questionnaire

The questionnaire was realized using Questback EFS Survey 10.3. It was promoted using e-mail lists of the Institute of Psychology at Technische Universität Braunschweig and via social networks. The questionnaire was promoted as a questionnaire "related to interactions of bicycle riders and car drivers" and was online from July 4, 2019 to January 12, 2020. Participants were included if they held a valid driving license. Students of psychology were given course credit; all others were thanked for their participation.

2.2. Participants

The questionnaire was promoted over social media and university- and traffic research- related mailings lists as well as over personal invitations and further snowballing; therefore, resulting in a convenience sample. Out of 194 subjects who landed on the first page of the questionnaire, 108 completed the questionnaire resulting in a dropout rate of 43%. Of these, 88 (81%) indicated their gender to be female, 19 (18%) to be male and one (1%) to be divers. Participants were aged from 18 to 59 ($M = 25.1$, $SD = 9.0$) years with 85% of participants being under the age of 30. 64% reported having finished any type of secondary education and 33% held a university degree.

About half of the sample (47.2%) identifies themselves as bicyclists, 39.8% identified themselves as car drivers and 12.9% identified as neither of them. 51.9% of participant reported to ride their bicycle almost daily or more than once a week, only 8.3% reported to never ride a bicycle. Of those who ride their bicycle, 57.5% enjoy very much or enjoy to do so, 9% do not enjoy or not at all riding a bicycle. 31.3% of the bicycle riders reported their riding style to be defensive or rather defensive, 29.2% as neutral, and 38.3% as rather dynamic or dynamic.

For car driving, yearly mileage was rather low, with 33.3% reporting to drive <3000 km/year and all others but one reporting drive between 3000 and 20,000 km/year. The one person reporting more mileage did so as they were a professional driver. 49.2% enjoy driving very much or enjoy driving, 25% are rather neutral about it, and 14.7% do not enjoy or not at all enjoy driving. 67.5% reported their driving style to be defensive or rather defensive, and 31.4% as rather dynamic or dynamic. In comparison to the general German population, the sample was younger, more educated, used their bicycle more and the car far less often (Nobis, 2019).

2.3. Measures and instruments

The TPB predictors "attitude", "social norms", and "perceived behavioral control" towards overtaking bicycle riders with an unsafely small margin were measured using three questions each on a 7-point Likert scale (see Table 1).

Willingness to overtake a bicycle rider as well as perceived risk of overtaking bicycle riders in this situation were also indicated by participants on a 7-point Likert scale each for six traffic sketches. In these sketches, infrastructure layout was systematically varied on two dimensions: (1) streets with or without a center-line between directions of travel and (2) streets marked with either a cycle lane, an advisory lane for bicycle riders or none of these (see Table 2). Legally safe overtaking of the bicycle rider was not possible in any of the sketches. Order of traffic sketches was counterbalanced between participants. Order of measurements (TPB first or sketches first) was also counterbalanced between participants.

2.4. Analyses

All statistical analyses were performed using SPSS Statistics Version 26 for PC. For both dependent variables, a repeated measures ANOVA (see Table 3) with center line and cycling street markings as independent variables, and attitude, social norms, and perceived behavioral control, as well as age and gender of participants, as covariates, was conducted. Additionally, *generalized eta squared* (η^2_G; Bakeman, 2005) was calculated in order to compare effect sizes for all effects within the mixed design.

3. Results

Fig. 1 shows means and standard deviations of participants' intention to overtake as well as perceived risk for overtaking in the six conditions.

Within-subject analyses showed that the intention to overtake was influenced by cycle lane markings ($F(1.704; 173.802) = 4.881$; $p = .012$; $\eta^2_p = 0.046$; $\eta^2_G = 0.018$) and the interaction of attitude and cycle lane markings ($F(1.704; 173.802) = 4.461$; $p = .017$; $\eta^2_p = 0.042$; $\eta^2_G = 0.016$), showing that intention to overtake was higher with markings than without, and even higher when attitude towards unsafely small distances to overtake was more positive, implying a moderating effect of attitude on the "cycle lane markings" – "intention" relationship. According to Bakeman (2005), effect sizes are both small, showing the interaction term to increasing the overall explained variance at the same rate as the infrastructure manipulation. The interaction term for cycle lane markings and center line marking also turned significant ($F(1.863; 190.040) = 3.216$; $p = .046$; $\eta^2_p = 0.031$; $\eta^2_G = 0.008$), indicating a very small additional moderating effect of center line markings on the "cycle lane markings" – "intention" relationship. For the between-subjects-terms, the intercept ($F(1.000; 102.000) = 7.345$; $p = .008$; $\eta^2_p = 0.067$; $\eta^2_G = 0.013$), as well as gender were significant ($F(1.000; 102.000) = 8.757$; $p = .004$; $\eta^2_p = 0.079$; $\eta^2_G = <0.001$), but none of the covariates (i.e. TPB predictors) was, showing that people differed in their intentions to overtake generally and between genders, but none of the TPB predictors alone explained any variance in these differences. The overall effect size of the gender difference is negligible. Post hoc tests showed differences between "no markings" and "advisory lane" ($p < .001$) as well as between "no markings" and "cycle lane" ($p < .001$), but none between "advisory lane" and "cycle lane" ($p = .932$). To sum this up: if there is any cycle lane marked, participants intention to overtake was stronger than without. Additional center line markings enhance this effect. An overall negligibly small, but significant effect of gender exists, with males having higher intentions to overtake bicycle riders. If subjects report more positive attitudes to overtake bicycle riders with a smaller than safe margin, the effect of cycle lane markings is enhanced.

Ratings of risk while overtaking were, in the within-subject analysis, influenced by a small interaction effect of cycle lane markings and gender ($F(1.699; 173.286) = 4.841$; $p = .013$; $\eta^2_p = 0.045$; $\eta^2_G = 0.018$), showing that ratings of risk were lower for any males on marked lanes . For the between-subjects-terms, the intercept ($F(1.000; 102.000) = 7.345$; $p = <0.001$; $\eta^2_p = 0.165$; $\eta^2_G = 0.030$), as well as gender were significant ($F(1.000; 102.000) = 7.874$; $p = .006$; $\eta^2_p = 0.072$; $\eta^2_G = <0.001$), but none of the covariates (i.e. TPB predictors) was, showing that people differed in risk rating

Table 1
TPB Questionnaire and descriptive statistics.

		Scale	M	SD
TPB predictors				
Attitudes (α = 0.835)			*5.79*	*1.23*
1	Overtaking bicycle riders with a margin of less than two times the widths of the handlebars is [good … bad]	1…7	5.59	1.31
2	Overtaking bicycle riders with a margin of less than two times the widths of the handlebars is [pleasant … unpleasant]	1…7	5.98	1.30
3	Overtaking bicycle riders with a margin of less than two times the widths of the handlebars is [disadvantageous … advantageous]	1…7	5.43	1.38
Norms (without question 3: α = 0.715)			*3.85*	*1.59*
1	Most people that are important to me overtake bicycle riders with a margin of less than two times the widths of the handlebars [definitely agree… definitely disagree]	1…7	3.76	1.66
2	Most people that are like me overtake bicycle riders with a margin of less than two times the widths of the handlebars [definitely agree… definitely disagree]	1…7	3.94	1.93
3	Car drivers generally overtake bicycle riders with a margin of less than two times the widths of the handlebars [definitely agree… definitely disagree]	1…7	3.37	1.37
Perceived behavioral control (without question 3: α = 0.752)			*4.32*	*1.50*
1	I am able to safely overtake bicycle riders with a margin of less than three times the widths of the handlebars [definitely disagree… definitely agree]	1…7	5.26	1.75
2	I am able to safely overtake bicycle riders with a margin of less than two times the widths of the handlebars [definitely disagree… definitely agree]	1…7	3.39	1.61
3	I am able to safely overtake bicycle riders with a margin of less than one time the widths of the handlebars [definitely disagree… definitely agree]	1…7	1.77	1.39

Table 2
Example sketches for the six tested scenarios.

	without center-line	with center-line
no markings		
advisory lane		
cycle lane		

generally and between genders, but none of the TPB predictors alone explained any variance in these differences.

4. Discussion

In this online study bicycle infrastructure had an influence on drivers' intention to overtake bicycle riders. With marked cycle lanes/advisory lanes, participants indicated more willingness to and feeling safer while overtake bicycle riders than without cycle lane markings. The effect of bicycle infrastructure on the intention to overtake was moderated by participants' attitudes towards overtaking bicycle riders with unsafely small margins.

Despite 'only' using an online-questionnaire based design, the result for the influences of infrastructure design agrees with those of Beck et al. (2019), Debnath et al. (2018), as well as the German studies (Huemer et al., 2018; Richter et al., 2019; Tagesspiegel, 2018), which used a simulator approach (Huemer et al., 2018) or observational methods (Beck et al., 2019; Debnath et al., 2018; Richter et al., 2019; Tagesspiegel, 2018).

Of the TBP predictors, only attitude moderated (enhanced) the effect of cycling street markings on the intention to overtake. While explained variance was generally low, the effects of street markings on overtaking intention and risk rating were about the same size as between subject differences. The significant interaction term implies a moderating effect of attitude on the "street-markings" – "intention" relationship, albeit this effect was only marginally adding to the overall variance explained. Data analysis suggest that personal motivations as measured by TPB factors play a less important role in the intention to overtake bicycle riders with a non-safe distance than infrastructure designs do, but unsafe attitudes towards overtaking bicycle riders may enhance infrastructures' effects. The judgement of risk for a given situation seems to be influenced by some markings on the street as well as gender but not by personal motivations. For the influences of driver characteristics on overtaking behavior few studies exist. Haworth et al. (2018) found their respondents in a large Australian sample to be more likely to disobey the legal minimal distance when reporting less frequently observing drivers to obey the law, which may be interpreted in line on social norms. They also found drivers who did not believe in the efficacy of the law to obey less, as well as drivers who reported it to be difficult to judge the distance while overtaking which may be interpreted as similar to perceived behavioral control. In a recent study, Goddard et al. (2020) found negative attitudes towards bicycle riders to negatively affect overtaking distances and overtaking speed in a driving simulator study, which is in line with our results.

4.1. Limitations

The within-subjects design required each subject to pass through each of the conditions. This resulted in a fairly uniform test setup, except for the changed independent variables. This constellation of conditions could have been challenging for the test subjects, especially to maintain concentration.

The sample was rather young: Due to the few kilometers driven by the test subjects each year and the low frequency of driving a motor vehicle, it can be said that driving experience is currently low. It therefore remains to be seen how the results would look if the age of the test persons varied more, if equally older and younger as well as persons with greater driving experience participated.

In this study, only a fraction of the road conditions that could have an influence on the overtaking behavior of the car driver have been investigated. In a recent review, Rubie et al. (2020) discuss other influences of road and traffic factors, bicycle rider characteristics and motorist characteristics on overtaking behavior.

We only used a short TPB questionnaire for personal motivations in this study, further investigations may add measures of risk perception or risky driving behaviors like the DBQ (Parker et al., 1995).

The study was conducted as an online survey, so 'only' reported intentions have been used as dependent variables, not 'actual' behavior as it may be possible in driving simulator studies when wanting to still also interview subjects about their motivations. (But still, simulator studies are an arbitrary setting).

Table 3
Results of the repeated measures ANOVA on intention to overtake and estimated risk for overtaking the bicycle riders.

Effect	df	df (Error)	F	p		η_p^2	η_G^2
Dependent variable: Intention to overtake							
intercept	1.000	102.000	7.354	0.008	**	0.067	0.013
attitude	1.000	102.000	0.070	0.791			
norms	1.000	102.000	1.025	0.314			
PBC	1.000	102.000	0.961	0.329			
age	1.000	102.000	0.391	0.533			
gender	1.000	102.000	8.757	0.004	**	0.079	<0.001
cycle lane markings	1.704	173.802	4.881	0.012	*	0.046	0.018
cycle lane markings * attitude	1.704	173.802	4.461	0.017	*	0.042	0.016
cycle lane markings * norms	1.704	173.802	0.935	0.381			
cycle lane markings * PBC	1.704	173.802	1.259	0.283			
cycle lane markings * age	1.704	173.802	0.897	0.395			
cycle lane markings * gender	1.704	173.802	1.641	0.200			
center line	1.000	102.000	3.956	0.049			
center line * attitude	1.000	102.000	0.406	0.526			
center line * norms	1.000	102.000	1.670	0.199			
center line * PBC	1.000	102.000	0.060	0.808			
center line * age	1.000	102.000	2.520	0.116			
center line * gender	1.000	102.000	0.054	0.817			
cycle lane markings * center line	1.863	190.040	3.216	0.046	*	0.031	0.008
cycle lane markings * center line * attitude	1.863	190.040	1.634	0.200			
cycle lane markings * center line * norms	1.863	190.040	0.145	0.851			
cycle lane markings * center line* PBC	1.863	190.040	3.026	0.054			
cycle lane markings * center line* age	1.863	190.040	1.506	0.225			
cycle lane markings * center line* gender	1.863	190.040	0.854	0.420			
Dependent variable: Risk							
Intercept	1.000	102.000	20.094	<0.001	***	0.165	0.030
Attitude	1.000	102.000	0.000	0.991			
Norms	1.000	102.000	0.665	0.417			
PBC	1.000	102.000	1.395	0.240			
age	1.000	102.000	0.401	0.528			
gender	1.000	102.000	7.874	0.006	**	0.072	< 0.001
cycle lane markings	1.699	173.286	1.121	0.321			
cycle lane markings * attitude	1.699	173.286	1.895	0.160			
cycle lane markings * norms	1.699	173.286	0.305	0.702			
cycle lane markings * PBC	1.699	173.286	0.594	0.527			
cycle lane markings * age	1.699	173.286	0.265	0.731			
cycle lane markings * gender	1.699	173.286	4.841	0.013	*	0.045	0.018
center line	1.000	102.000	0.761	0.385			
center line * attitude	1.000	102.000	0.012	0.912			
center line * norms	1.000	102.000	1.736	0.191			
center line * PBC	1.000	102.000	0.093	0.761			
center line * age	1.000	102.000	0.641	0.425			
center line * gender	1.000	102.000	0.917	0.341			
cycle lane markings * center line	1.995	203.529	1.479	0.230			
cycle lane markings * center line * attitude	1.995	203.529	0.118	0.888			
cycle lane markings * center line * norms	1.995	203.529	0.861	0.424			
cycle lane markings * center line* PBC	1.995	203.529	1.594	0.206			
cycle lane markings * center line* age	1.995	203.529	0.316	0.729			
cycle lane markings * center line* gender	1.995	203.529	1.491	0.228			

* significant α < 0.05; ** significant α < 0.01; *** significant α < 0.001.

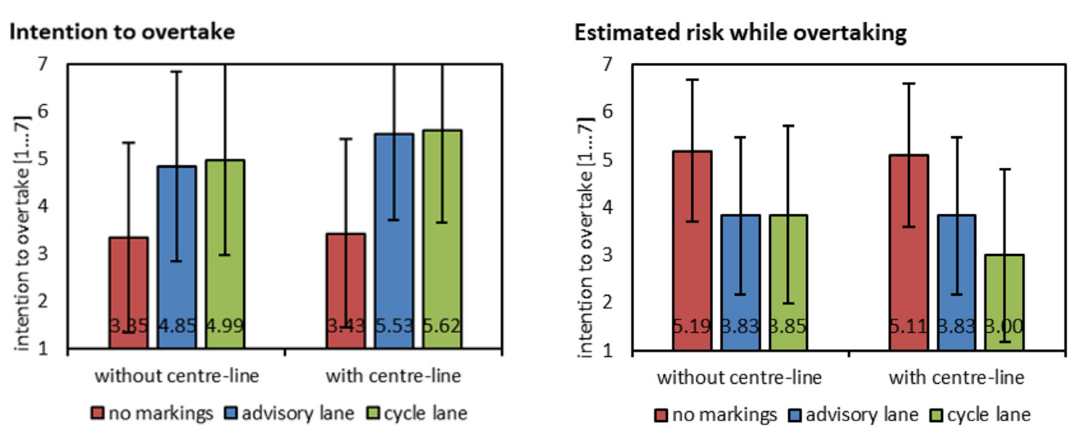

Fig. 1. Means and standard deviations for participants' intention to overtake the bicycle rider and estimated risk for overtaking the bicycle riders in the six scenarios.

Implications

The study's design, using the TPB predictors as covariates in the statistical model and thereby as a between-person moderator, and the traffic sketches as within-subject independent variables, allows to compare the relative influences of proximal infrastructure and more distal personal motivation components directly with each other. Results show, that for this configuration of persons in infrastructure, infrastructure's effect is a more important predictive for subject's intention to overtake bicycle riders in a non-safe manner.

As traffic research is concerned with improving traffic safety in an efficient manner, studies like this are able to inform about the appropriate measure to improve traffic safety. Therefore, future studies should aim to combine (distal to the situation) personal factors as well as infrastructural (proximal to the situation) to be able to compare those effects with each other. If similar the effects on intention, or even better, measured behavior in traffic (e.g. in simulator studies) are found, this might give some hope to be able to make traffic interactions safer by infrastructure design without the need of hope for personality change in road users. Thus, self-explaining road design (Theeuwes and Godthelp, 1995) might be the most effective measure for traffic safety. For the configuration examined here, changes in infrastructure seem to be the best measure. For marked on-road cycling factifies, this implies, that to be safe, margins of those markings must encourage appropriate behavior and therefore they need to generous enough to facilitate safe overtaking maneuvers. For other safety problems, e.g. motorcyclists' crashes, other, more person-related measures might be appropriate, as there, personal decisions for unsafe riding practices play a more important role in crashes (e.g., Elliot et al., 2007).

Conclusions

Concerning the first aim of the study, the feasibility for online-studies for initial investigation of infrastructure layouts, it seems like this may be possible, but will need further exploration in different settings. For the second aim, comparing different sets of predictors (personals as well as infrastructural) for intentions for unsafe overtaking of bicycle riders, the approach was successful and showed that, in a given situation, personal factors are less important than those forming the situational possibilities more closely. This does, of course, not say that personal factors are never predictive of traffic behavior, but they may play more important roles in less externally restricted traffic situations that have more degrees of freedom for them to show in intentions and even actual behavior.

CRediT authorship contribution statement

A.K. Huemer: Conceptualization, Supervision, Methodology, Formal analysis, Visualization, Writing - original draft, Writing - review & editing. **F.M. Strauß:** Investigation, Formal analysis, Writing - original draft.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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